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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/830,120	04/23/2004	Jung-hyun Lee	249/456	9015

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EXAMINER	
STARK, JARRETT J	
ART UNIT	PAPER NUMBER
2823	

MAIL DATE	DELIVERY MODE
02/06/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/830,120	LEE ET AL.	
	Examiner	Art Unit	
	Jarrett J. Stark	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 November 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3-7,9-11 and 25-36* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3-7,9-11 and 25-36* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection.

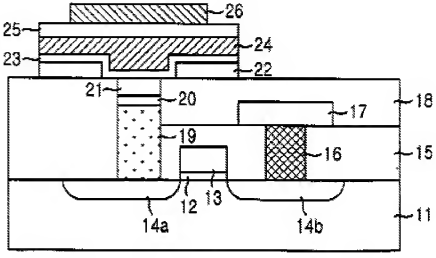
Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1,3-7, 9-11 and 25-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kweon et al. (US 2003/0057445 A1) in view of the following comments.

FIG. 1B
(RELATED ART)



Regarding claim 1, Kweon et al. discloses a stack-type capacitor comprising:

a lower electrode on a diffusion barrier layer (Kweon et al, Fig. 1b → [23] and [24]);

a dielectric layer formed on the lower electrode (Kweon et al, Fig. 1b→[25]); and an upper electrode formed on the dielectric layer (Kweon et al, Fig. 1b →[26]);

wherein the lower electrode includes:

a first metal layer having a cylindrical shape and defining a cylindrical space (Kweon et al, Fig. 1b); and

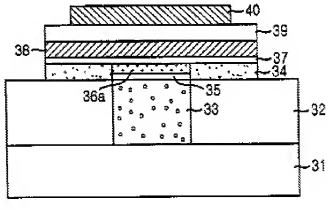
a second metal layer completely filling the cylindrical space defined by the first metal layer (Matsui et al, Fig. 9d),

the second metal layer has a greater reacitivity towards oxygen than the diffusion barrier layer (This is the known and understood properties and reason a barrier layer is conventionally used in the art when forming these types of devices)

the diffusion barrier is a nitride layer (Kweon et al, paragraph [0019] --> layer [21] is TiN); and

In the embodiment depicted by Figure 1B of Kweon, Kweon does not explicitly state the layer 24 is a nitride aluminum layer. Kweon does however disclose when describing later embodiments that second metal layer of lower electrodes can comprise a nitride aluminum layer (Kweon et al, paragraph [0055] and Figure 4E --> second metal layer [38] can be TiAlN, first metal layer [37] can be Ru and the barrier layer [36a] can be TiN.);

FIG. 4E



It would have been obvious to one having ordinary skill in the art at the time the invention was made to form a two layer bottom electrode of the claimed materials, since it has been held to be within the general skill of a worker in the art to select a known

material on the base of its suitability, for its intended use involves only ordinary skill in the art. *In re Leshin*, 125 USPQ 416.

It would be obvious to one of ordinary skill in the art at the time of the invention to form the multilayered capacitor structure with the claimed material layers disclosed by Kwion fig. 4E having a lower electrode with the cylindrical shape as shown in Figure 1b (above). The shape of a capacitor's electrodes is merely a matter of design choice. The capacitance of a capacitor is proportional to the surface area of the conducting plate and inversely proportional to the distance between the plates. It is also proportional to the permittivity of the dielectric substance that separates the plates. The capacitance of a capacitor is given by:

$$C \approx \frac{\varepsilon A}{d}; A \gg d^2$$

where ε is the permittivity of the dielectric, *A* is the area of the plates and *d* is the spacing between them. Thus, the area A and the spacing d are merely optimized for the desired size and shape in order to meet specific design specifications.

"When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense." KSR Int'l Co v. Teleflex Inc.

Regarding claim 3 & 10, Kweon disclose the capacitor as claimed in claim 2 & 9, wherein the nitride and aluminum layer is a titanium aluminum nitride layer (Kweon et al, paragraph [0055]).

Regarding claim 4 & 11, Kweon disclose the capacitor as claimed in claim 2 & 9, wherein the upper electrode is a ruthenium layer (Kweon, paragraph [0006]).

Regarding claim 5, Kweon discloses a semiconductor memory device including a stack-type capacitor, the device comprising a transistor and a capacitor (Kweon, paragraph [0007]), wherein the capacitor includes: (Matsui et al, Abstract)

a lower electrode on a diffusion barrier layer (Kweon et al, Fig. 1b → [23] and [24]);

a dielectric layer formed on the lower electrode (Kweon et al, Fig. 1b→[25]); and an upper electrode formed on the dielectric layer (Kweon et al, Fig. 1b →[26]);

wherein the lower electrode includes:

a first metal layer having a cylindrical shape and defining a cylindrical space (Kweon et al, Fig. 1b); and

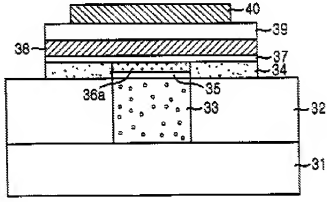
a second metal layer completely filling the cylindrical space defined by the first metal layer (Matsui et al, Fig. 9d),

the second metal layer has a greater reacitivity towards oxygen than the diffusion barrier layer (This is the known and understood properties and reason a barrier layer is conventionally used in the art when forming these types of devices)

the diffusion barrier is a nitride layer (Kweon et al, paragraph [0019] --> layer [21] is TiN); and

In the embodiment depicted by Figure 1B of Kweon, Kweon does not explicitly state the layer 24 is a nitride aluminum layer. Kweon does however disclose when describing later embodiments that second metal layer of lower electrodes can comprise a nitride aluminum layer (Kweon et al, paragraph [0055] and Figure 4E --> second metal layer [38] can be TiAlN, first metal layer [37] can be Ru and the barrier layer [36a] can be TiN.);

FIG. 4E



It would have been obvious to one having ordinary skill in the art at the time the invention was made to form a two layer bottom electrode of the claimed materials, since it has been held to be within the general skill of a worker in the art to select a known material on the base of its suitability, for its intended use involves only ordinary skill in the art. *In re Leshin*, 125 USPQ 416.

It would be obvious to one of ordinary skill in the art at the time of the invention to form the multilayered capacitor structure with the claimed material layers disclosed by Kwion fig. 4E having a lower electrode with the cylindrical shape as shown in Figure 1b (above). The shape of a capacitor's electrodes is merely a matter of design choice. The capacitance of a capacitor is proportional to the surface area of the conducting plate and inversely proportional to the distance between the plates. It is also proportional to the permittivity of the dielectric substance that separates the plates. The capacitance of a capacitor is given by:

$$C \approx \frac{\varepsilon A}{d}; A \gg d^2$$

where ε is the permittivity of the dielectric, *A* is the area of the plates and *d* is the spacing between them. Thus, the area A and the spacing d are merely optimized for the desired size and shape in order to meet specific design specifications.

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Regarding claim 6, Kweon discloses the device as claimed in claim 5, wherein the transistor is electrically connected to the capacitor by a conductive plug (Kweon al, Fig. 1b).

Regarding claim 7, Kweon discloses the device as claimed in claim 6, wherein a diffusion barrier layer is formed between the lower electrode and the conductive plug (Kweon al, Fig. 1b).

Regarding claim 9, Kweon discloses the capacitor as claimed in claim 5, wherein the first metal layer is a ruthenium layer (Kweon, paragraph [0006]).

Regarding claims 25 and 31, Kweon discloses wherein the second metal layer is TiAlN.

Regarding claim 26 and 32, Kweon discloses wherein the diffusion barrier layer is TiN. TiN is substantially free of aluminum.

Regarding claim 27 and 33, Kweon discloses wherein:

The diffusion barrier layer consists of a first set of compounds, an the second metal layer included the first set of compounds and a material that is reactive towards oxygen (see Kweon, paragraphs [0050-0055] which teaches the various commonly used materials forming the claimed layers of this type of capacitor and diffusion layer.)

> [0050] Herein, the glue layer 34 is a metal layer containing iridium and silicon, e.g., IrSi.sub.x. The connection unit 100 employs, for example, a poly-Si plug as the plug 33, a Ti-silicide layer as the ohmic contact layer 35 and a the surface of the TiN layer 36a is planarized with that of the glue layer 34.

[0051] Meanwhile, a conductive layer for the plug 33 of the connection unit 100 is made of one member selected from the group consisting of poly-Si, tungsten (W), W-silicide, TiN, TiAlN, TaSiN, TiSiN, TaN, TaAlN, TiSi, TaSi and combination thereof.

[0052] The barrier layer 36a of the connection unit 100 is formed by one member selected from the group consisting of TiN, TaN, TiSiN, TiAlN, RuTiN and RuTiO and is conductive so as to connect the poly-Si plug 33 with the bottom electrode 38.

[0053] The ohmic contact layer 35 of the connection unit 100 is made of one member selected from Ti-silicide, CoSi and MoSi.

[0054] The interlayer insulating layer 32 is made of one member selected from the group consisting of boron silicate glass (BSG), boron phosphor silicate glass (BPSG), a high density plasma (HDP) oxide layer, undoped silicate glass (USG), tetra ethyl ortho silicate (TEOS), advanced planarization layer (APL) oxide layer, spin on glass (SOG) and mixtures thereof.

[0055] The diffusion **barrier layer 37** for suppressing oxide diffusion, the **bottom electrode 38** and the **top electrode 40** are formed by one member selected from the group consisting of Pt, Ir, IrO.sub.x, **Ru,** RuO.sub.x, Rh, RhO.sub.x, Os, OsO.sub.x(x=1.about.2), Pd, PdO.sub.x(x=1.about.2), CaRuO.sub.3, SrRuO.sub.3, BaRuO.sub.3, BaSrRuO.sub.3, CaIrO.sub.3, SrIrO.sub.3, BaIrO.sub.3, (La, Sr)CoO.sub.3, Cu, Al, Ta, Mo, W, Au, Ag, WSi.sub.2, TiSi.sub.2, MoSi.sub.x(x=0.3.about.2), CoSi.sub.x(x=1.about.2)- , NbSi.sub.x(x=0.3.about.2), TaSi.sub.x(x=1.about.2), TiN, TaN, **WN**, TiSiN, **TiAlN,** TiBN, ZrSiN, ZrAlN, MoSiN, MoAlN, RuTiN, IrTiN, TaSiN, **TaAlN** and mixtures thereof.

[0056] The dielectric layer 39 is made of a ferroelectric layer or a layer having a high dielectric constant, which can include Ta.sub.2O.sub.5, STO(SrTiO.sub.3), BST, PZT, PLZT((Pb, La)(Zr, Ti)O.sub.3), BTO(BaTiO.sub.3), PMN(Pb(Ng.sub.1/3Nb.sub.2/3)O.sub.3), SBTN((Sr, Bi)(Ta, Nb).sub.2O.sub.9), SBT((Sr, Bi)Ta.sub.2O.sub.9), BLT((Bi, La)Ti.sub.3O.sub.12) and PT(PbTiO.sub.3).

Regarding claim 28 and 34, Kweon discloses wherein the material that is reactive towards oxygen includes aluminum (Kweon, paragraph [0055] -- discloses the same materials)

Regarding claim 29 and 35, Kweon discloses wherein the diffusion barrier layer includes titanium and nitride, tungsten and nitride and/or tantalum and nitride (Kweon, paragraph [0055]).

Regarding claim 30 and 36, Kweon discloses, wherein the first metal layer is disposed proximate to and substantially equidistant to both the diffusion barrier layer and the second metal layer (Kweon, figures 1b and 4E).

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jarrett J. Stark whose telephone number is (571) 272-6005. The examiner can normally be reached on Monday - Thursday 7:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Jarrett J Stark
Examiner
Art Unit 2823

JJS
January 29, 2008

/Michelle Estrada/
Primary Examiner, Art Unit 2823